US008403170B1

(12) **United States Patent**
Lai

(10) **Patent No.: US 8,403,170 B1**
(45) **Date of Patent: Mar. 26, 2013**

(54) **PRESSURE VESSEL**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/451,919**

(22) Filed: **Apr. 20, 2012**

(51) **Int. Cl.**
F17C 5/02 (2006.01)
B65D 25/04 (2006.01)

(52) **U.S. Cl.** **220/581**; 220/721; 220/720; 220/723

(58) **Field of Classification Search** 220/586, 220/581, 720, 721, 723, 584, 592, 565, 529, 220/530, 601, 574, 4.12; 138/30, 26
See application file for complete search history.

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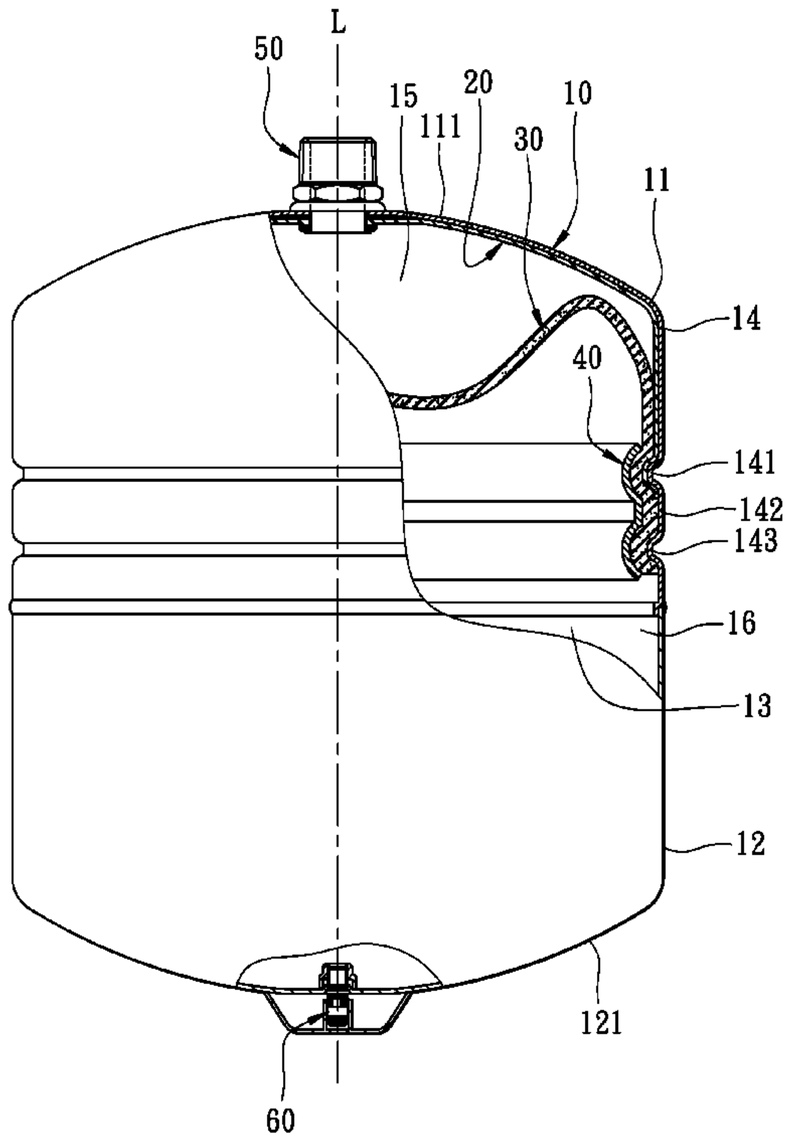
(57) **ABSTRACT**

A pressure vessel includes: an outer container unit having an inner space and first and second supporting portions; a lining container disposed inside the outer container unit and having an end portion that corresponds to the first supporting portion; an elastic diaphragm disposed in and dividing the inner space into air and water chambers, and having retaining and extending sectors that correspond in position to the end portion and the second supporting portion respectively; and a pressing member disposed in the air chamber and having first and second pressing segments that press tightly the retaining sector and the end portion against the first supporting portion and the extending sector on the second supporting portion respectively.

4 Claims, 3 Drawing Sheets



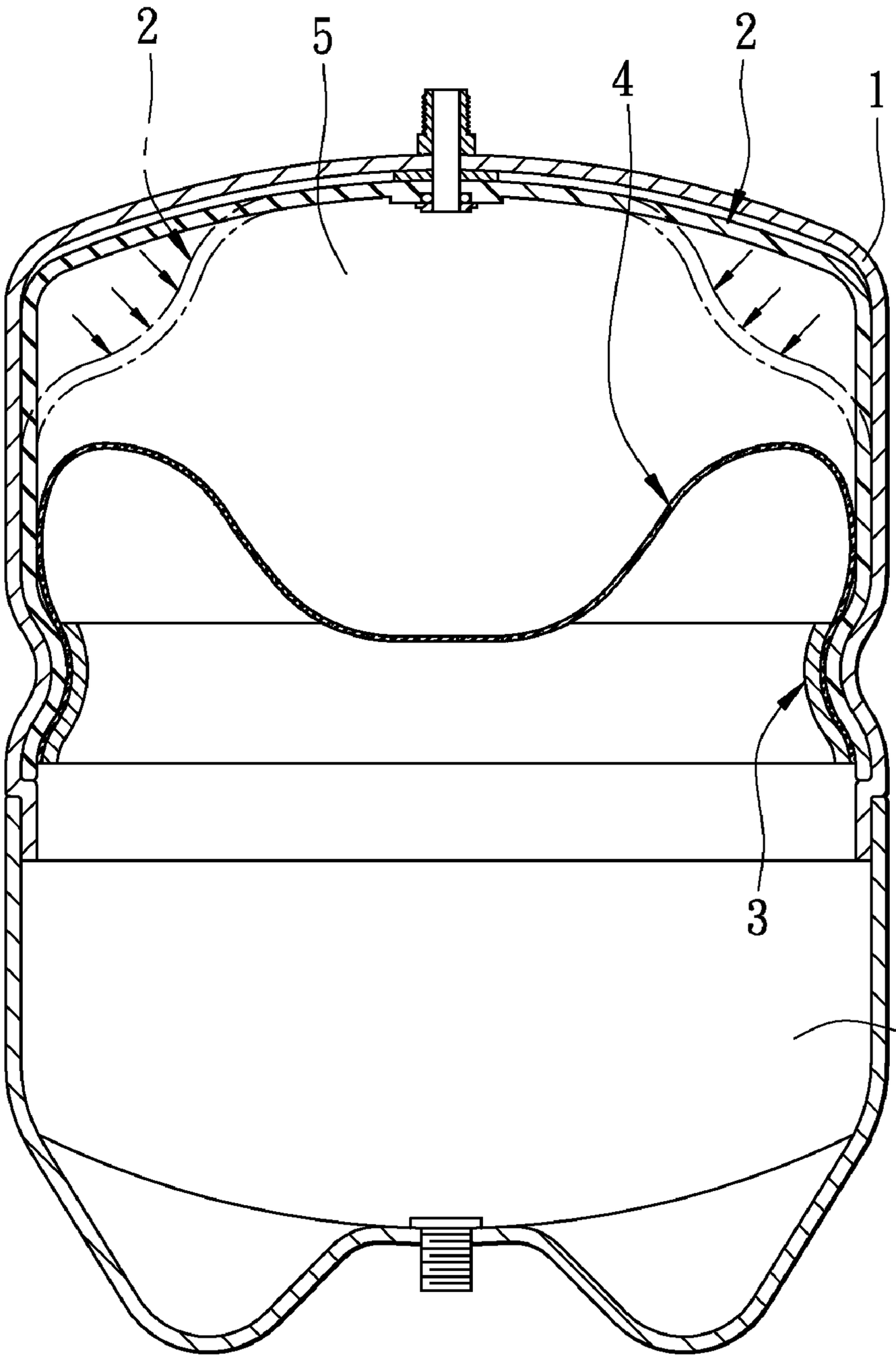


FIG. 1
PRIOR ART

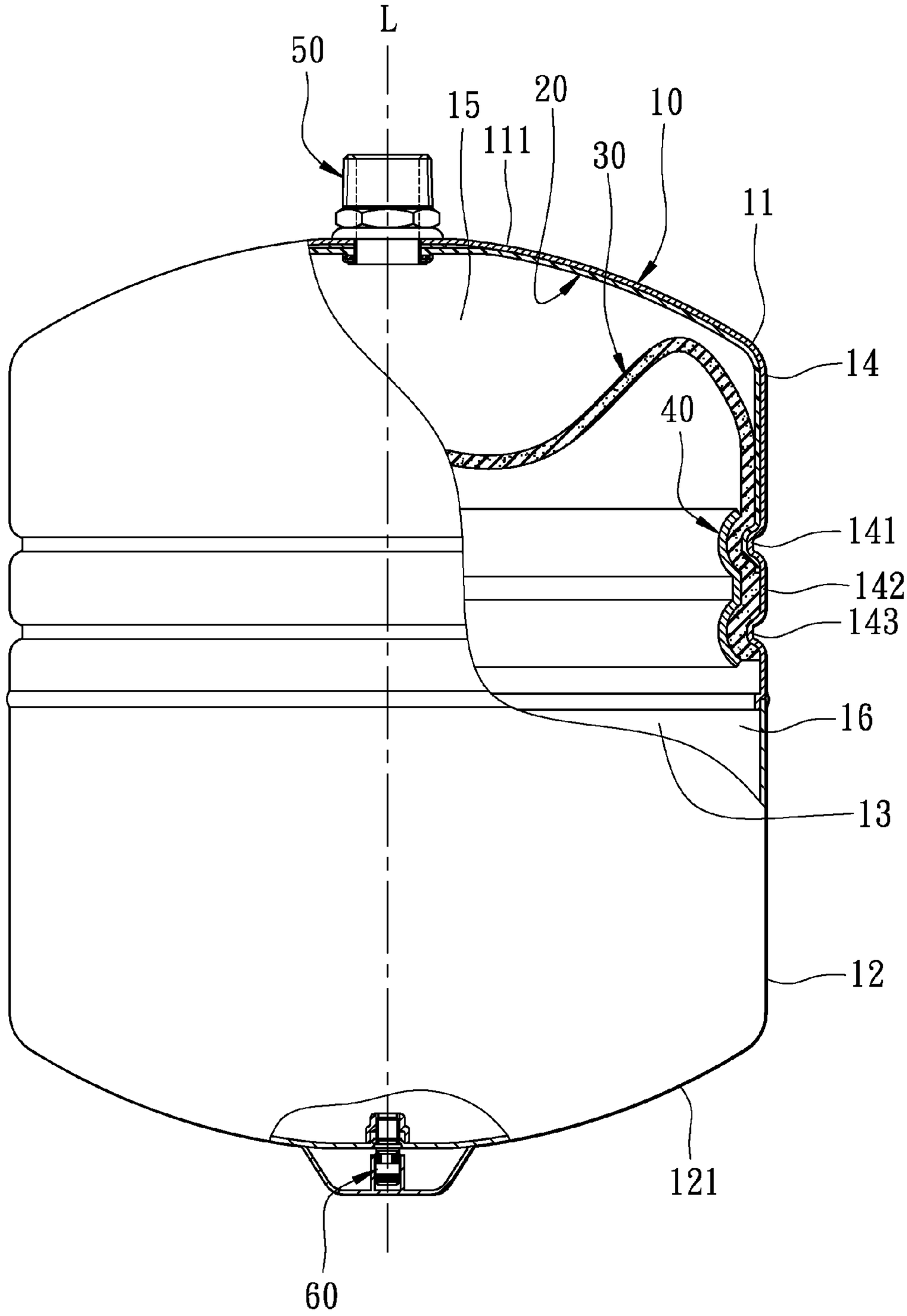
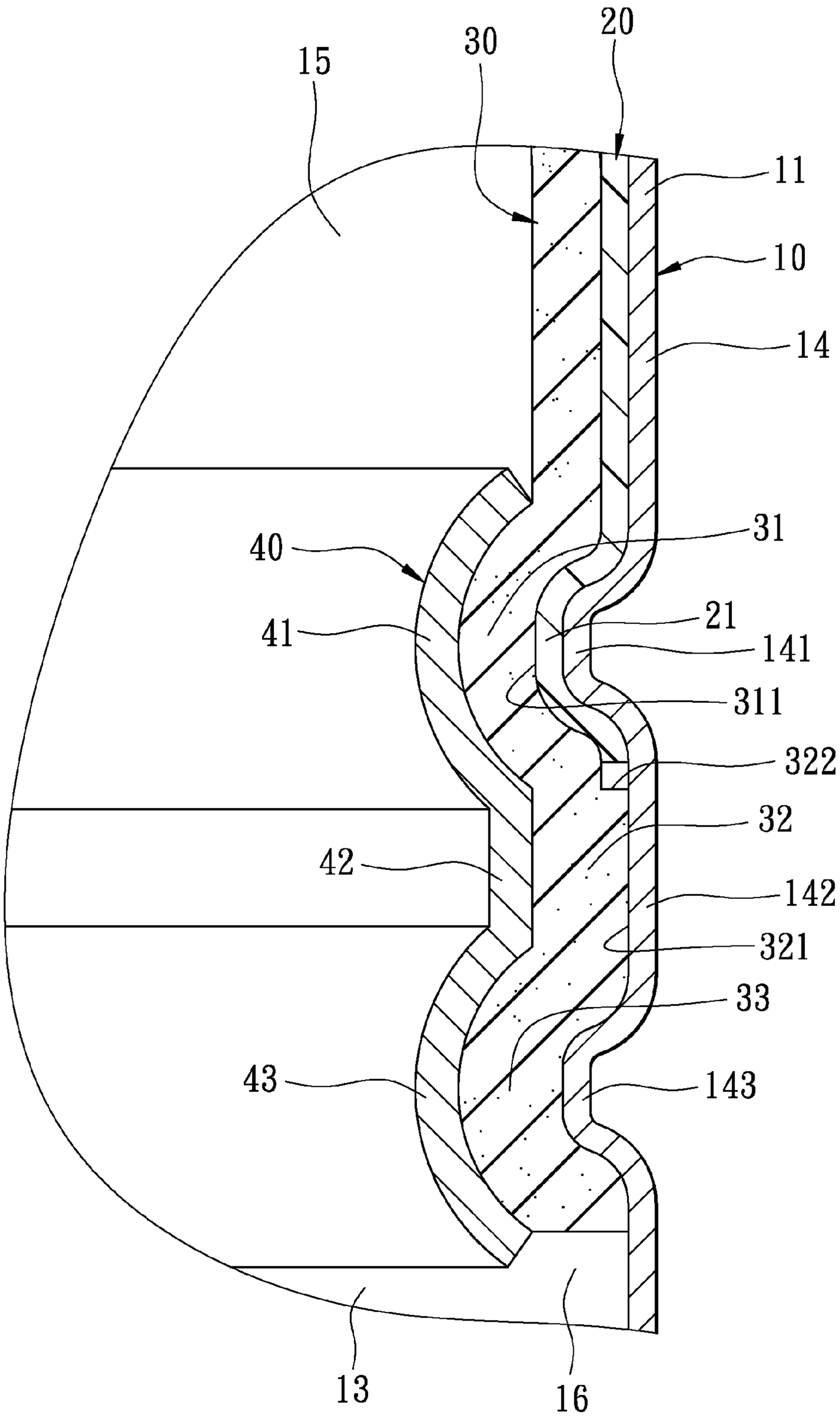


FIG. 2


15
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43
143
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16

FIG. 3

PRESSURE VESSEL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a pressure vessel, more particularly to a pressure vessel having a structure for preventing deformation of a lining container therein.

2. Description of the Related Art

Hydro-pneumatic pressure vessels are widely used in industrial and residential piping systems. For example, hydro-pneumatic pressure vessels are used for stabilizing water pressure and absorbing water hammers in hydraulic piping systems, absorbing thermal expansion in closed hot water systems and storing water in reverse osmosis systems.

As shown in FIG. **1**, a pressure vessel disclosed in Taiwanese Patent Publication No. 533,905 includes an outer container **1**, a plastic lining container **2** sleeved by the outer container **1**, and an elastic diaphragm **4** having an end portion that is clamped between an end portion of the lining container **2** and a pressing member **3**. The diaphragm **4** divides an inner space of the outer container **1** into an air chamber **6** and a water chamber **5** that corresponds to the lining container **2**. Despite being widely used, the above-mentioned pressure vessel suffers from a drawback: coupling between the outer container **1** and the lining container **2** is not air-tight, such that high-pressure air in the air chamber **6** may leak into a space between the outer container **1** and the lining container **2**. Once the pressure in the water chamber **5** drops suddenly to be much smaller than the pressure in the space between the outer container **1** and the lining container **2**, the lining container **2** may deform toward the water chamber **5**. The deformation of the lining container **2** may be irreversible and may have an adverse effect on performance of the pressure vessel.

SUMMARY OF THE INVENTION

Therefore, the object of the present invention is to provide a pressure vessel having a structure for preventing deformation of a lining container therein.

Accordingly, a pressure vessel of the present invention comprises:

an outer container unit having a surrounding wall that surrounds an axis, and first and second end walls that are spaced apart from each other along the axis and that cooperate with the surrounding wall to define an inner space, the surrounding wall having a first supporting portion and a second supporting portion, the first supporting portion being disposed between the second supporting portion and the first end wall;

a lining container disposed inside the first outer container and disposed to contact the first end wall and a portion of the surrounding wall, and having an end portion that corresponds in position to the first supporting portion;

an elastic diaphragm disposed in the inner space, and dividing the inner space into an air chamber and a water chamber that corresponds to the lining container, the diaphragm having a retaining sector that corresponds in position to the end portion of the lining container, and an extending sector that is connected to the retaining sector and that corresponds in position to the second supporting portion of the surrounding wall; and

a pressing member surrounding the axis, disposed in the air chamber, and having a first pressing segment that presses tightly the retaining sector of the diaphragm and the end portion of the lining container against the first supporting portion of the surrounding wall, and a second pressing segment that presses tightly the extending sector of the diaphragm against the second supporting portion of the surrounding wall.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiment with reference to the accompanying drawings, of which:

FIG. **1** is a sectional view of a conventional pressure vessel having a lining container;

FIG. **2** is a partly sectional view of a preferred embodiment of a pressure vessel according to the invention; and

FIG. **3** is an enlarged fragmentary sectional view of the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIGS. **2** and **3**, a preferred embodiment of a pressure vessel according to the present invention comprises an outer container unit **10**, a lining container **20**, an elastic diaphragm **30**, a pressing member **40**, a water fitting **50** and an air valve **60**.

The outer container unit **10** has a surrounding wall **14** that surrounds an axis (L), and first and second end walls **111**, **121** that are spaced apart from each other along the axis (L), that are connected to opposite ends of the surrounding wall **14**, and that cooperate with the surrounding wall **14** to define an inner space **13**. The outer container unit **10** includes a first container body **11** and a second container body **12** that is welded to the first container body **11**. The abovementioned first and second end walls **111**, **121** are formed respectively in the first and second container bodies **11**, **12**, while the surrounding wall **14** is formed in the first and second container bodies **11**, **12**. The surrounding wall **14** has an annular first supporting portion **141** and an annular second supporting portion **142** located in the first container body **11**. The first supporting portion **141** is disposed between the second supporting portion **142** and the first end wall **111**.

Preferably, the surrounding wall **14** of the outer container unit **10** further has an annular third supporting portion **143** that is formed at one side of the second supporting portion **142** opposite to the first supporting portion **141** along the axis (L). Both of the first and third supporting portions **141**, **143** are inwardly-curved.

The lining container **20** is disposed inside the outer container **10** and disposed to entirely contact the first end wall **111** and a portion of the surrounding wall **14**, and has an annular end portion **21** that is inwardly-curved with respect to the axis (L) and that corresponds in position to the first supporting portion **141** of the surrounding wall **14**.

The diaphragm **30** is made of rubber, and is disposed in the inner space **13** and divides the inner space **13** into an air chamber **16** and a water chamber **15** that corresponds to the lining container **20**. The diaphragm **30** has a retaining sector **31** that corresponds in position to the end portion **21** of the lining container **20**, and an extending sector **32** that is connected to the retaining sector **31** and that corresponds in position to the second supporting portion **142** of the surrounding wall **14**. The retaining sector **31** has a retaining surface **311** that is in contact with the end portion **21** of the lining container **20**, the extending sector **32** has a thickness larger than that of the retaining sector **31** and has a contact surface **321** that is in contact with the second supporting portion **142** of the surrounding wall **14**, and the diaphragm **30** further has

a shoulder portion formed between the retaining and extending sectors **31**, **32** and having a shoulder surface **322** that confronts a distal end of the end portion **21** of the lining container **20**.

Preferably, the diaphragm **30** further has a stop sector **33** connected to the extending sector **32** and corresponding in position to the third supporting portion **143** of the surrounding wall **14**.

The pressing member **40** is disposed in the air chamber **16**, surrounds the axis (L), and has an annular first pressing segment **41** and an annular second pressing segment **42**.

The first pressing segment **41** is disposed to press tightly the retaining sector **31** of the diaphragm **30** and the end portion **21** of the lining container **20** against the first supporting portion **141** of the surrounding wall **14**.

The annular second pressing segment **42** is disposed to press tightly the extending sector **32** of the diaphragm **30** against the second supporting portion **142** of the surrounding wall **14**. Both the first pressing segment **41** and the retaining sector **31** of the diaphragm **30** are inwardly-curved with respect to the axis (L).

Preferably, the pressing member **40** further has an annular third pressing segment **43** connected to the second pressing segment **42**, corresponding in position to the stop sector **33** of the diaphragm **30**, and pressing the stop sector **33** against the third supporting portion **143** of the surrounding wall **14**. The third pressing segment **43** and the stop sector **33** are both inwardly-curved with respect to the axis (L).

The water fitting **50** is disposed on the first container body **11** and communicates fluidly with the water chamber **15**.

The air valve **60** is disposed on the second container body **12** and communicates fluidly with the air chamber **16**.

Since the contact surface **321** of the extending sector **32** of the diaphragm **30** is in contact with the second supporting portion **142** of the surrounding wall **14** of the outer container unit **10**, and the extending sector **32** is pressed tightly against the second supporting portion **142** by the second pressing segment **42** of the pressing member **40**, the lining container **20** and the outer container unit **10** are coupled air-tightly to each other, and the configuration of the third pressing member **43**, the stop sector **33**, and the third supporting portion **143** further reinforces the coupling between the lining container **20** and the outer container unit **10**. Hence, high-pressure air in the air chamber **16** would not escape into a space between the lining container **20** and the outer container unit **10**. That is, when a pressure in the water chamber **15** drops suddenly, the lining container **20** is prevented from deforming toward the water chamber **5**, such that performance of the pressure vessel is maintained.

During manufacturing of the pressure vessel, the outer container unit **10**, the lining container **20**, the elastic diaphragm **30**, and the pressing member **40** are assembled before the inwardly-curved structures (the first pressing segment **41**, the retaining sector **31**, the end portion **21**, the first supporting portion **141**, the third pressing segment **43**, the stop sector **33**, and the third supporting portion **143**) are formed by rolling. At that time, the shoulder portion of the diaphragm **30** would abut against the end portion **21** of the lining container **20** for positioning adequately the diaphragm **30** relative to the lining container **20** and the outer container unit **10**.

It should be noted that the air valve **60** may be omitted in a modification in which inflation of the air chamber **16** is achieved through sublimation of solid carbon dioxide in the air chamber **16**. Moreover, the third supporting portion **143** of the surrounding wall **14** of the outer container unit **10**, the stop sector **33** of the diaphragm **30**, and the third pressing segment **43** of the pressing member **40** may also be omitted without significantly compromising the capability of the preferred embodiment to achieve the desired effect of relatively improved airtightness between the lining container **20** and the outer container unit **10**.

While the present invention has been described in connection with what is considered the most practical and preferred embodiment, it is understood that this invention is not limited to the disclosed embodiment but is intended to cover various arrangements included within the spirit and scope of the broadest interpretation so as to encompass all such modifications and equivalent arrangements.

What is claimed is:

1. A pressure vessel comprising:

an outer container unit having a surrounding wall that surrounds an axis, and first and second end walls that are spaced apart from each other along the axis and that cooperate with said surrounding wall to define an inner space, said surrounding wall having a first supporting portion and a second supporting portion, said first supporting portion being disposed between said second supporting portion and said first end wall;

a lining container disposed inside said outer container unit and disposed to contact said first end wall and a portion of said surrounding wall, and having an end portion that corresponds in position to said first supporting portion;

an elastic diaphragm disposed in said inner space, and dividing said inner space into an air chamber and a water chamber that corresponds to said lining container, said diaphragm having a retaining sector that corresponds in position to said end portion of said lining container, and an extending sector that is connected to said retaining sector and that corresponds in position to said second supporting portion of said surrounding wall; and

a pressing member surrounding the axis, disposed in said air chamber, and having a first pressing segment that presses tightly said retaining sector of said diaphragm and said end portion of said lining container against said first supporting portion of said surrounding wall, and a second pressing segment that presses tightly said extending sector of said diaphragm against said second supporting portion of said surrounding wall; wherein:

each of said first supporting portion of said outer container unit, said end portion of said lining container, said retaining sector of said diaphragm, and said first pressing segment of said pressing member is annular and inwardly-curved;

said surrounding wall of said outer container unit further has a third supporting portion formed at one side of said second supporting portion opposite to said first supporting portion along the axis;

said diaphragm further has a stop sector connected to said extending sector and corresponding in position to said third supporting portion of said surrounding wall of said outer container unit;

said pressing member further has a third pressing segment connected to said second pressing segment, corresponding in position to said stop sector of said diaphragm, and pressing said stop sector of said diaphragm on said third supporting portion of said surrounding wall of said outer container unit; and

each of said third supporting portion of said outer container unit, said stop sector of said diaphragm, and said third pressing segment of said pressing member is annular and inwardly-curved.

2. The pressure vessel as claimed in claim **1**, wherein:

said retaining sector of said diaphragm has a retaining surface contacting said end portion of said lining container;

said extending sector of said diaphragm has a thickness larger than that of said retaining sector and has a contact surface contacting said second supporting portion of said surrounding wall of said outer container unit; and

said diaphragm further has a shoulder portion formed between said retaining and extending sectors and having a shoulder surface that confronts a distal end of said end portion of said lining container.

3. The pressure vessel as claimed in claim **1**, wherein:

said outer container unit includes a first container body and a second container body welded to said first container body;

said first and second end walls are formed respectively in said first and second container bodies;

said surrounding wall is formed in said first and second container bodies; and

said first and second supporting portions are located in said first container body.

4. The pressure vessel as claimed in claim **3**, further comprising a water fitting disposed on said first container body and communicating fluidly with said water chamber, and an air valve disposed on said second container body and communicating fluidly with said air chamber.

* * * * *